

WATER URBANISM IN BOGOTÁ

EXPLORING THE INTERPLAY BETWEEN SETTLEMENT PATTERNS AND WATER MANAGEMENT

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ABSTRACT:

A paradigm shift in water management is perceived as a necessary and fundamental step for adaptation to climate change and crucial for furthering sustainability. In contexts of rapid urbanization, this paradigm shift is particularly challenged; at the heart of this are social issues and specific forms of city production, the latter of which are partially shaped by processes that previously denied the landscape structure. The Bogotá Savanna is an unevenly urbanized area with a population of 8,661,534. Its scale and complexity emphasise the need for an approach, which is both flexible and strategic; the future of the 'urban' depends on the ability to reformulate traditional disciplines and methods. The unsustainable over-extension of urbanization on the Bogotá Savanna, its current vulnerability to flooding, large-scale pollution and the serious shortcomings of water management have made it crucial to not only reconsider the water system but to drastically transform it, augmenting its resilience. Additionally, one of the biggest challenges facing the city is the provision of 300,000 low-income housing units and the upgrading of living conditions in informal settlements. Environmental and liveability issues have stronger impacts on the periphery, where informal settlements are located, than in the rest of the city. This condition reinforces the strong and polarized geography of centrality and marginality. The question is what would happen if urbanization trends would be reversed into a constructive interplay with water? This article investigates the evolution of water management and its relationship to urbanization in El Tintal watershed, a sub-watershed of the Bogotá River. This watershed is occupied by informal settlements as well as recent large social housing projects. Through the analysis of this landscape, mapping and historical research, this article provides a basis for future design explorations of the spatial potential of the water system and for context-responsive solutions to this wet and fertile plateau.

KEY WORDS: Bogotá, water management, informal settlements, landscape urbanism, low-income housing

FROM HARD TO SOFT ENGINEERING

Worldwide, the impacts of water dynamics are being increasingly made evident. This, consequently, has highlighted the deficiencies in the management of water systems in general and the spread of standardized practices of pipe engineering in particular. In response, a ‘water paradigm shift’ has emerged during the last two decades. This shift suggests a transition from a ‘hard’ engineering approach, linear, sealed, isolated, mono-functional and ecologically dysfunctional, to a ‘soft’ engineering approach, meandering, diverse purposed, viable biota and functional ecology (Novotny 2011: 113). Rather than the conventional approach of building barriers, perpetually increasing the height of the dikes and expanding drainage, the new hydraulic logic demands the incorporation of soft measures and strategic ecological interventions. The primary objective of these practices is to deal with the problems at its source in a preventive way rather than controlling it with reactionary measures.

Different studies point out the negative influence of urban areas on the hydrological balance of the watershed. Therefore, the paradigm shift is strongly focused on the hydrological cycle management within these areas. Imperviousness, reducing ground water levels, increasing runoff and diffuse pollution are the main indicators of the negative effects of urbanization on the water cycle (Nolf 2011: 413). Certain changes in the hydrological properties are difficult to quantify since they are not readily visible in the short-term, such as changes in groundwater levels. However, the effect of the reduction of permeability of the soil due to buildings, roads or other paved areas has been studied extensively. Impervious surfaces reduce rainwater infiltration, increase stormwater runoff, peak overflows and diffuse pollution. Soil erosion is also associated with the increased speed of water flows (Jacobson 2011: 1438). Reduced infiltration leads to declining groundwater levels in the long term with consequences for waterways and wetlands.

In addition, other research has indicated that the type of drainage has an important effect in increasing runoff. ‘While rainfall depth and catchment characteristics have a greater control on runoff depths and runoff ratios, the likelihood of runoff from limited amounts of rainfall increases with impervious channelization’ (Gallo et al 2013:50). Urbanization also affects the natural geo-morphological conditions that mitigate the effects of the rains. Connectivity is essential to prevent raw sewage overflows and to increase security and resilience; there is less risk of failure if the system is not fragmented. Connectivity is also essential to ensure the sustainability conditions of aquatic biota and terrestrial ecology (Novotny 2012: 123).

This paradigm shift in urban water management promotes an interdisciplinary approach contrary to traditional practices in which infrastructure, urbanism and ecology were designed as independent systems. In the new paradigm, sustainable water management demands are incorporated into spatial demands of city planning. In this framework, Water Sensitive Urban Design (WSUD) integrates water management, urban design, and landscape planning. It considers all parts of the urban water cycle and combines the functionality of water management with principles of urban design (Dickhaut 2011: 14). Considering the importance of runoff management in sustainable urban water management, many techniques are primarily focused on sustainable stormwater management. The main objective is “to reduce stormwater runoff by treating the stormwater as close to the source as possible, ideally on-site.

‘Treat’ in this case does means to reduce runoff by using technologies for stormwater collection (e.g. for utilization or storage) and to increase stormwater infiltration and evaporation” (Dickhaut 2011: 14).

FROM URBAN FORM TO LANDSCAPE STRUCTURE

In the same way, environmental concerns have also permeated the urban disciplines. In recent decades, the central role of urban form in the study of cities has shifted putting renewed emphasis on the landscape as a structure. Traditional urban design was founded in a condensed medium, focusing on the definition of urban form and public space. However, the traditional concepts of ‘city’ and ‘urbanity’ require a re-definition due to the inevitable sprawl and the homogeneous horizontal extension of urban areas. Different approaches have emerged in response, such as Landscape Urbanism. Landscape urbanism re-emphasizes “the importance of particular sites and of the ecological/ artificial processes they encompass” (Waldheim 2006). It aims to produce solutions intertwined with local conditions, preventing the trend of globalization and homogenization of the built environment (Frampton 1995, Shannon 2004). The emphasis on landscape performance and function places water as a fundamental topic on the agenda.

The main criticism of landscape urbanism is based on the absence of the “more conservative urban reading and analysis of existing processes and structures” and its lack of presence in the context of “necessity and survival” (Shannon 2004). In the context of rapid urbanization, the need to shift from hard engineering approaches to more soft engineering approaches not only offers the possibility of re-integrating infrastructure as an instrumental landscape (Belanger 2010:348) but also of providing a structure to program different uses, re-incorporate meanings and explore new settlement patterns.

WATER CRISIS IN THE BOGOTÁ SAVANNA

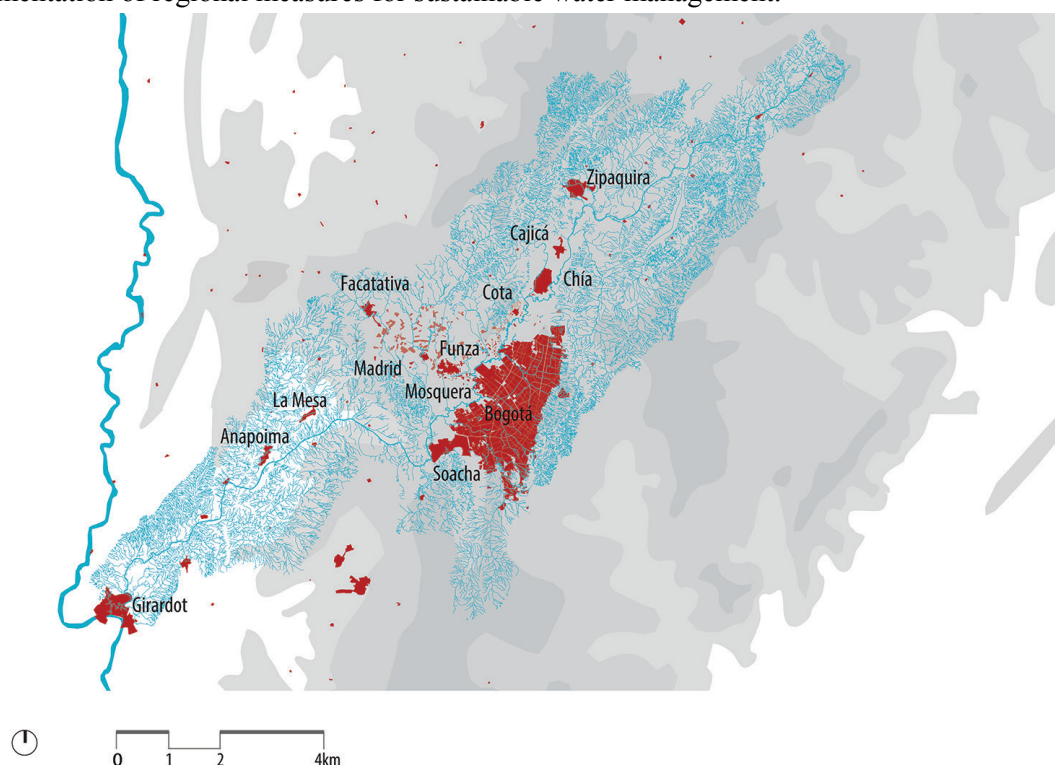
Since the 1930s, urbanization in the Bogotá Savanna has accelerated, causing a reduction in the landscape resilience, fragmentation of the ecosystems and a radical change in the water balance. The main challenges faced in Bogotá River Basin are the recovery of water quality and flood control along its course. To this extent, it is necessary to control the increase of impervious surfaces as well as to implement actions to reformulate the water system and ensure its continuity. New design strategies that understand the ecological process of specific sites can help to re-define urban edges that are closely associated with water bodies and should be taken into account in the projection of the region.

SUB-URBANIZATION AND PERIPHERY

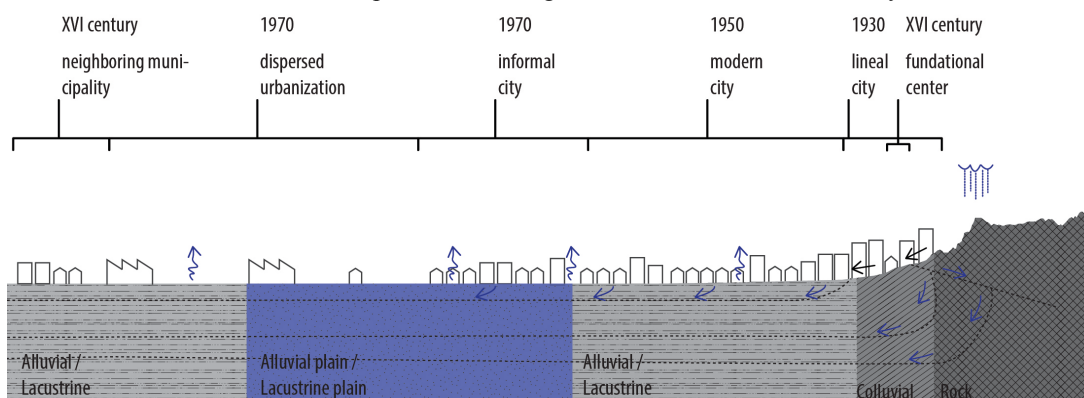
Urbanization in the Bogotá Savanna has followed the unplanned development processes driven by the limited availability of land and its high cost within the administrative boundary of the Bogotá city. This process has formed a dense urban fringe just in the border this boundary and a dispersed sub-urban tissue around the surrounding municipalities. The urban fringe, composed of soils with geomorphological vulnerability (flood or landslide), is mainly inhabited by low-income settlements. The occupation of the sub-urban tissue reflects the economic capacity of the population and follows regional roads¹ [fig. 1].

¹ High and upper middle income population settles in the north and northeast corridor. (Cota, Tenjo, Chia, Cajicá, Tocancipá and La Calera). Middle and upper low income population settles in the northwestern corridor

Urban sprawl and the consequent increase of impervious surfaces occur mainly in the flat part of the Savanna, which was a lagoon, for much of the Quaternary (Veloza 2013:26) [fig. 2]. This explains the tendency to pooling in winter-time and the difficulties of drainage that increase the effects of floods. The assessment of hydrological changes in the Bogotá River Basin made by Díaz-Granados and Camacho, shows that the green areas have reduced from 31% to 19% in only 20 years (Díaz-Granados & Camacho 2012: 82). The sub-urbanization is also fuelled by the construction of greenhouses for flower industries. The lack of regional planning and administrative integration obstructs the implementation of regional measures for sustainable water management.



[fig. 1] Urbanization in the Bogotá River watershed is located mostly in the plain area, a plateau at an average altitude of 2600m above sea level. This plateau was a lagoon, for much of the Quaternary.



[fig. 2] Schematic section of the growth of urbanization in relation to types of soils and topography. The city depended on water supply from upstream creeks until the 1930s. Modern infrastructure allowed urbanization spread over the plateau.

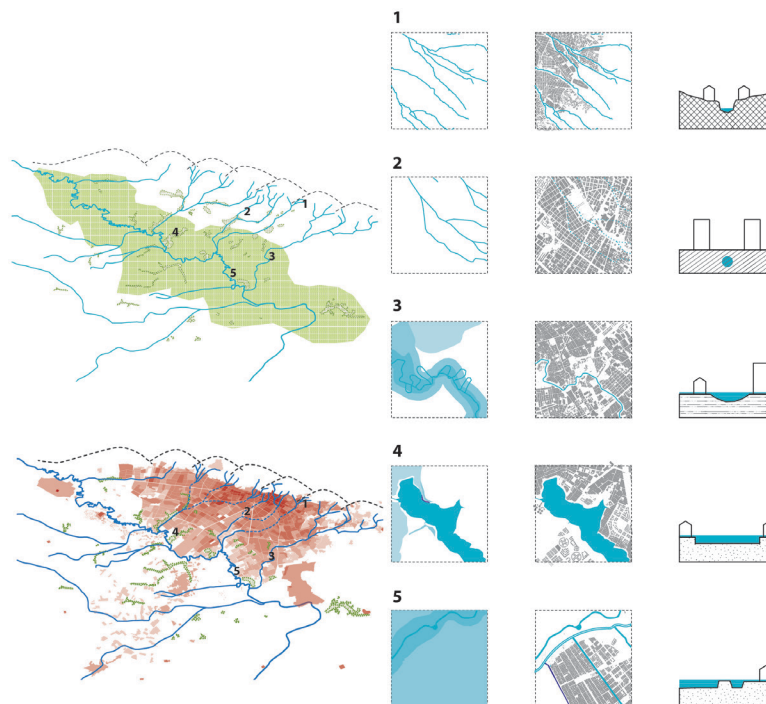
(Mosquera, Madrid, Facatativá). Low income population settles in the southwestern corridor (especially in Soacha, and less so in Sibaté) (Günter: 2004).

UNCOMPLETED WATER SYSTEM

Another challenge is the high degree of manipulation of the water system. In the name of modern advances, rivers were buried, canalized and rectified. The partially obsolete natural water system runs between concrete channels and has disappeared from the urban imaginary. The drainage system has considerable shortcomings, including a high percentage of faulty connections, direct discharges of wastewater to receiving waters and low flow capacity. Presently, a separate system is installed in most parts of the city; it consists of a canalized stream or an open canal for storm water with sewage interceptors running parallel to it. The main problem of the system, however, is that there are faulty connections between the sewage and the storm water system and vice versa (Giraldo 2000:30).

As a result of these faulty connections, untreated direct discharges are a major source of pollution. The Bogotá River receives all wastewater, in addition to the discharge of industrial waste and pollutants from neighbouring municipalities. In 1993, the city designed a sanitation system with three wastewater treatment plants (WWTP) at the mouth of the main tributaries, Salitre, Fucha and Tunjuelito rivers (Eaab 2006:36). At present, there is only one WWTP built in the Salitre River; the treatment capacity is approximately 11% of the total wastewater. In 2002 the design of the sanitation system was review. The city administration decided that only one more WWTP was necessary and that the capacity of the Salitre plant would be increased. Recent research by Universidad Nacional has indicated that the treatment capacity of the projected system is limited even if it is completely built (Gonzalez 2011: 143). The same research states the need to incorporate additional strategies to achieve water quality objectives, such as sustainable urban drainage systems, or to integrate existing wetlands to urban drainage systems (Gonzalez 2011: 143).

FRAGMENTED ECOLOGIES

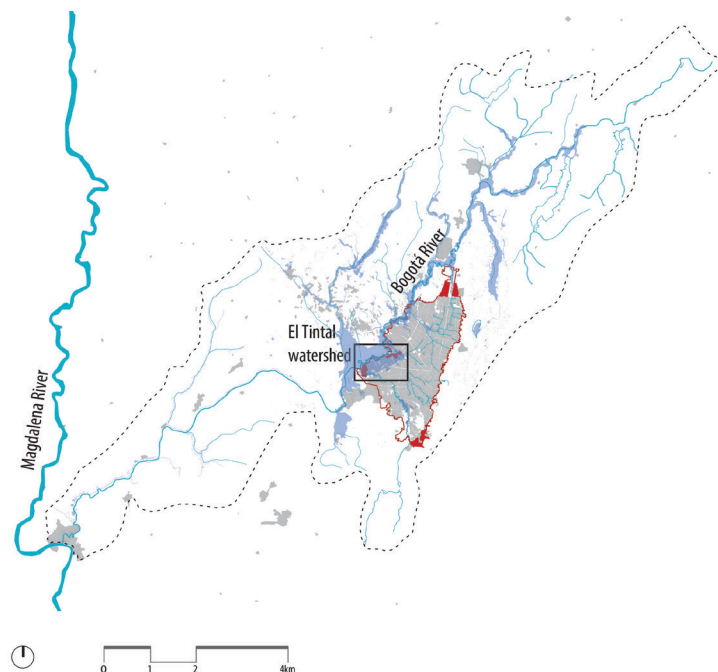


[fig. 3] Scheme of water system manipulation: (1) informally urbanized upstream creeks. (2) Buried rivers in the middle part of the city. (3) Urbanized floodplains and rectified rivers. (4) Urbanized downstream wetlands (5) Urbanization in the floodplain of the Bogotá River.

The extent of the manipulation of the water system affects its ecological functions. The spread of urbanization without any consideration of its impact on water has led to a serious fragmentation of the system. The reduction of the buffering areas such as floodplains and wetlands make it difficult to implement re-naturalization actions. Wetlands are one of the most affected components of the system, it is estimated that the urbanization of Bogotá dried approximately 49,000 hectares of wetlands (Viviescas 2006: 78) [fig. 3]. The limited number and size of remaining wetlands need urgent restoration and protection. However, the current surface does not appear sufficient to ensure the conservation of biodiversity (Van der hammen 2006: 47). The water system is not alone in needing to recover some of this lost space, biodiversity is also in need. The configuration of blue-green corridors and its integration with green areas for the management of water bodies is an option to reconfigure the environmental performance of the landscape.

CASE STUDY: EL TINTAL WATERSHED; FROM WET FLOODPLAIN TO DRY URBANIZATION

In the urbanized area of the city of Bogotá there are 6 sub-watersheds that are part of the Bogotá River basin. The sub-watershed El Tintal is located in the southern part of the Bogotá Savanna and has an area of 3,405 hectares, which cover the southern part of the localities of Kennedy and Bosa [fig. 4]. These localities contain a large proportion of the low-income population and have serious deficiencies in infrastructure, equipment and housing. The sub-watershed, El Tintal, corresponds mostly with the floodplain of the Bogotá River. In this area, the floodplain is wider, the groundwater level is highest, the river speed is slower and the meanders are broader. It is a flood prone area of flat topography that drains directly into the Bogotá River. These conditions restricted urbanization for several decades. Artificial drainage systems have gradually changed water conditions allowing the reclamation of this land.



[fig. 4] El Tintal watershed is located in the natural floodplain of the Bogotá River. The red areas show the new development projects within the administrative boundary of the Bogotá city.

Urbanization in the watershed has been driven by profit at the expense of urban and architectural quality. As a result, El Tintal watershed has been developed with generic dwellings. It also exemplifies the growth of the Bogotá periphery, based on the consolidation of urban fragments that emerged in response to the prevailing housing needs of low-income sectors (Tarchópulos & Ceballos 2005:59). The strategic integration of sustainable urban water management with spatial re-qualification strategies is an alternative to traditional upgrading projects that only focus on legalization of ownership and access to public utilities. The analysis below investigates five stages in the construction of the relationship between water and society in the watershed.

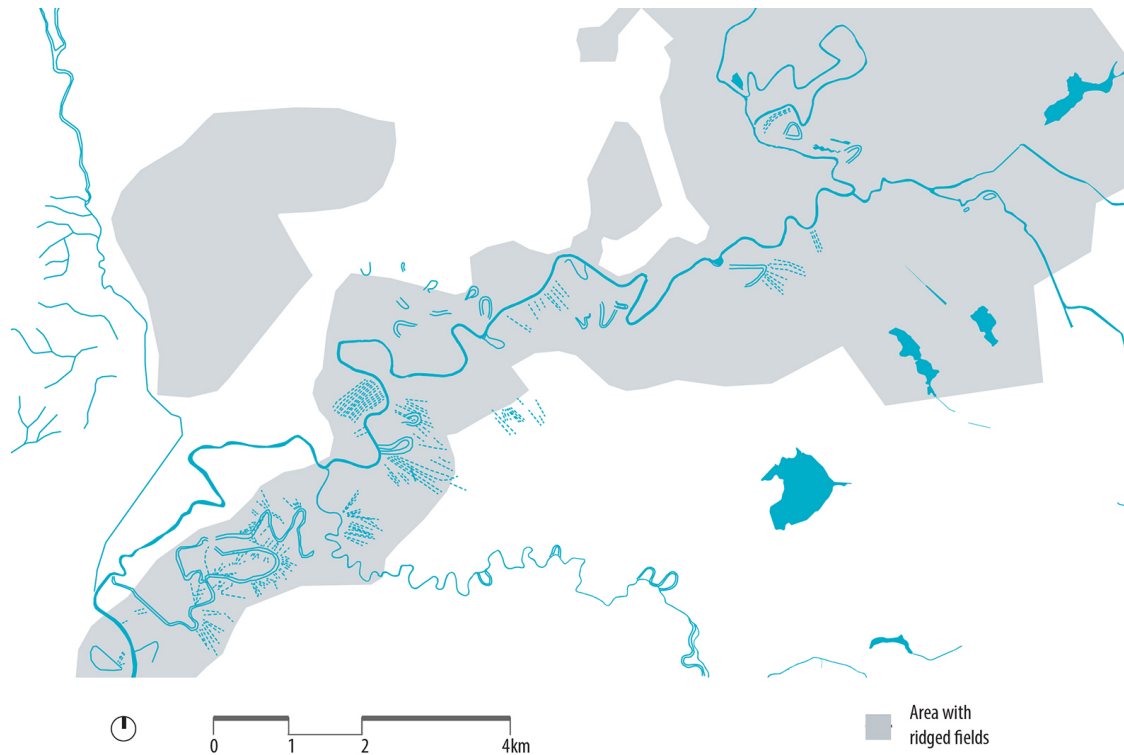
PRE-HISPANIC RIDGED FIELDS: AN INDIGENOUS LANDSCAPE URBANISM STRATEGY

During the pre-Hispanic era, the wet soils and the natural cycles of flooding in the Savanna were broadly exploited for the construction of extensive agricultural systems. Ridged fields were built to manage extremely wet soils. These are located in the floodplain of the Bogotá River, on the terraces near to the river and in the middle terrace located between the floodplain and the mountain slope (Boada 2006: 87). The ridged fields and canals served as a buffer area, improved drainage and soil conditions, controlled temperature differences and provided an appropriate space for fish farming (Bernal 1990: 45). Different studies have identified morphological variations of the raised fields depending on their location in relation to the river and the geomorphology of the Savanna (Boada 2006, Etayo 2002, Cavelier 2006). These variations are grouped into four: checkerboard ridges, irregular ridges, linear ridges and parallel to the river. The variations perform different functions; while some structures work well to retain water (checkerboard) others excel at draining it (linear or parallel) (Boada 2006: 100).

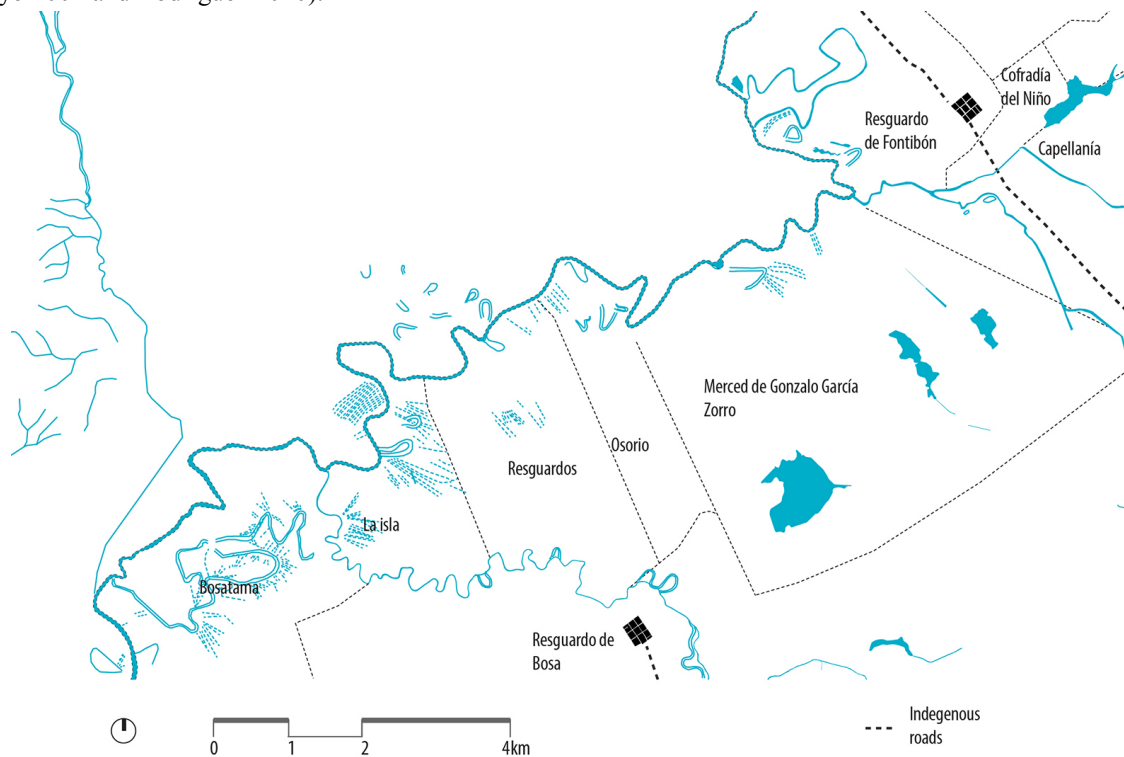
In the most recent research about the settlement patterns and intensive agricultural systems in the Bogotá Savanna, Ana Maria Boada identified 7,451 hectares where ridge fields existed [fig. 5]. The ridges in El Tintal watershed are predominantly linear, which responds to the need to drain the area. At present the patterns of the ridge fields in the confluence between the Tunjuelito and the Bogotá rivers are still visible. This area was recently declared as a wetland, however this remains largely unknown.

Archaeological evidence of Boada's study also confirms the concentration of higher population densities along the banks of the river Bogotá. During the Herrera period (300B.C. – 200A.D.), the population settled along the western bank in small villages at relatively regular distances from each other. It was only afterwards that they colonized the eastern bank. The villages grew in population during the periods of the Early Muisca (200A.D - 1000A.D) and Late Muisca (1000A.D - 1600A.D). During the latter period some villages were merged forming populations of major hierarchy (Boada 2006: 160). Although the population was relatively concentrated, dispersed settlements existed due to the need for proximity to ridged fields.

Some scholars argue that the indigenous landscapes are indeed the first roots of landscape urbanism (Shannon and Manawadu 2007:6). The careful and patient handling of water defined the productive ecosystem and the settlement patterns that operated on a regional scale. On the wet and fertile plateau, a 'water urbanism' strategy emerged as a context responsive solution to work with the forces of nature (De Meulder and Shannon 2008).



[fig. 5] Pre-Hispanic ridged fields were strategies of adaptation to the specific soil conditions and natural cycles of flooding. This system is evidence that another relationship with water is possible (Based on Boada 2006, Etayo 2002 and Rodríguez 2010).



[fig. 6] The imported grid appears in the sixteenth century as a maximum projection of Spanish order and control. The superimposition of new and alien physical and social structures is also exemplified by the new distribution of land.

‘PUEBLOS DE INDIOS’: IMPORTED VILLAGE AND LANDSCAPE ISOLATION

After the sixteenth century, the indigenous settlement pattern was radically replaced by either indigenous villages, called ‘pueblos de indios’, or the colonial city. The villages were founded with the intention to regroup the indigenous population in Spanish-type settlements in the areas with the highest population densities. In general, these villages occupied the river floodplain, while the colonial city ‘Santafé’ (today Bogotá) nested itself on the foothills, just on the strip of colluvial and well drained soils. The founding grid was projected and fitted between the San Francisco and San Augustin Rivers, following the ordinances of the Indian laws. The water supply and panoramic view of the Savanna were instrumental in the site selection, as well as the presence of indigenous settlements. In time, the colonial city grew isolated from the Bogotá River and the relations with the rest of the Savanna were structured following indigenous roads.

After the Spanish founded Santafé, they took possession over the rest of the territory. In the area near to El Tintal watershed, they founded the indigenous villages Bosa in 1539 and Fontibon 1594. The conquerors that decided to populate the Savanna became ‘encomenderos’, they enjoy the usufruct of indigenous labor but they did not have ownership rights over the land (Zambrano: 24). However, the ‘encomenderos’ appropriated the land, consolidating a structure that gave way to the estates. At the end of sixteenth century, a large part of the flood plain of the river Bogotá remained in indigenous hands in the form of reserves called ‘resguardos’, while another large part was given to the Spanish conquerors (Osorio, La Isla and Merced de Gonzalo García Zorro) [fig. 6]. In the eighteenth century, as part of the Bourbon reforms, some regulations were implementing to reduce their power and strengthen State presence. This allowed other social groups to acquire land in the Savanna. The Catholic Church was one of the groups that acquired much of the land. Many of which were received as donations from the faithful while other was purchased. (Delgado 2010: 103)



[fig. 7] Pintura de las tierras, pantanos y anegadizos del pueblo de Bogotá de 1614. This painting illustrates precisely the western bank of the Bogotá River and the municipalities of Madrid and Funza. The introduction of livestock changed the pre-Hispanic agricultural role of the floodplain. (Archivo General de Indias: mp – Panamá, 336, Escribanía cámara)

The change of land tenure was accompanied by the introduction of foreign techniques and the progressive abandonment of traditional agricultural techniques. Arguably, the biggest impact was the systematic introduction of estates that gave priority to the use of land as grazing for livestock² (Delgado 2010: 106). It is likely that cattle occupied the low-lying and easily flooded areas where the Muisca had installed a laborious canal system and where the most productive soils were located (Delgado 2010: 123) [fig. 7]. Crops were displaced to a higher and drier land. However, the irrigation and drainage structures were not fully developed and its limited capacity did not allow independence of storm water for irrigation (Mora 2011:7). The new imported village grew slowly, stretching the use and abuse of landscape, duplicating simple water supply systems and multiplying the disturbances to the ecosystem.

DITCHES, CANALS AND EUCALYPTUS: DRYING THE WET PLAIN

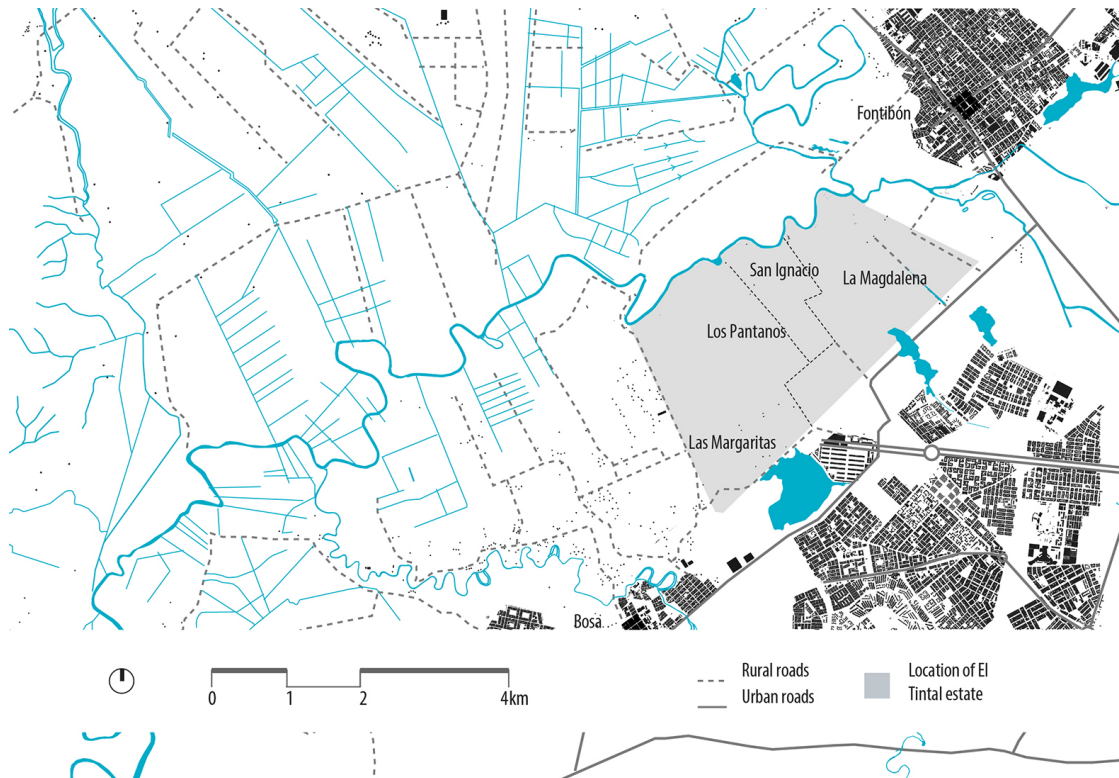
The first 'modern' drainage systems were introduced in order to adapt the marshy areas for agricultural and livestock production. By 1861, a project was initiated to reclaim about 6,400 hectares of land by draining all the marsh and swamps, but the project was suspended due to the civil war (Parra 1984). In the hacienda 'El Tintal', 192 hectares were reclaimed through another project that included the construction of several embankments, the drainage of wetlands and the construction of small reservoirs for irrigation in summer times (Parra 1984).

The construction of ditches enabled the occupation of frequently flooded lands. Ditches and canals were placed as a grid that also defined the boundaries of the estates [fig. 8]. The efforts to dry the Savanna were made in order to plant new foreign pastures to sustain the livestock production (Pardo 1949: 13). In the late nineteenth century, the introduction of Eucalyptus was another large scale effort. According to Perez Arbelaez in 1893, Don Pepe Urdaneta planted the first Eucalyptus in the Bogotá Savanna; other sources say that Eucalyptus was imported from New York by President Murillo Toro (Molina: 1995). The imported eucalyptus species in Bogotá were highly instrumental in drying-out the soil (Van der Hammen 2006: 46); it was used indiscriminately by the owners of the estates in order to "help in the task of drying the marshes" (Pardo 1949: 13).

IMPROVISING IN DENIAL: THE LOGICS OF INFORMAL TERRITORIAL OCCUPATION

The urban cores of Bosa and Fontibon grew insignificantly in comparison to Bogotá. Nevertheless, the low cost of land, the ability to acquire a plot and to have home ownership, motivated low-income populations to move to the periphery of the city. The first occupants came either from tenement houses in the city center with low levels of hygiene and sanitation or from the countryside, displaced by the violence of the 1950s. Until the 1960s, El Tintal watershed was dedicated almost exclusively to farming (Rosero & Gomez 1983: 21). In 1954, Bosa, Fontibon and another three municipalities were annexed to the administrative city limits.

²Livestock, as an economic activity, was particularly consolidated in the Savannah during the nineteenth century.



[fig. 8] Efforts to dry the floodplain started during the eighteen-century associated with the new estates and the need of pastures for livestock. Ditches and canals formed a grid, which is the basis of the current urban form. Based on IGAC 1975.



[fig. 9] The partially dried lands were gradually occupied by the barrios, the 'popular neighborhoods' that arise out of self-construction. Based on IGAC 1989.

The periphery of the city including El Tintal watershed was informally urbanized following the stages of settlement, subdivision, housing building and infrastructure construction (Tarchopulos & Ceballos 2005: 37). The informal settlement process started in the 1960s with the subdivision of the estates. The drainage system of ditches and canals configured the morphology of the settlements [fig. 9]. As the construction of infrastructure was the last stage of the process, the informal settlement preserved the original agricultural drainage, partially using it as a sewerage. Only after the approbation of the legalization conducted by public entities, these settlements gained access to water supply and waste water collection.

Paradoxically, the emergence of informal settlements is associated with the modernization of the city. Modernization allowed the implementation of large-scale infrastructure, a fundamental jump in scale from the previous developments. Urban density decreased while urbanization was spreading over the plateau. Modernization and informality implied alienation from nature, strongly contrasting the indigenous landscape urbanism strategies. Over time, the development strategies became purely technical, and as such, urbanism detached itself step by step from the landscape.

HARD INFRASTRUCTURE AND HOUSING TISSUES

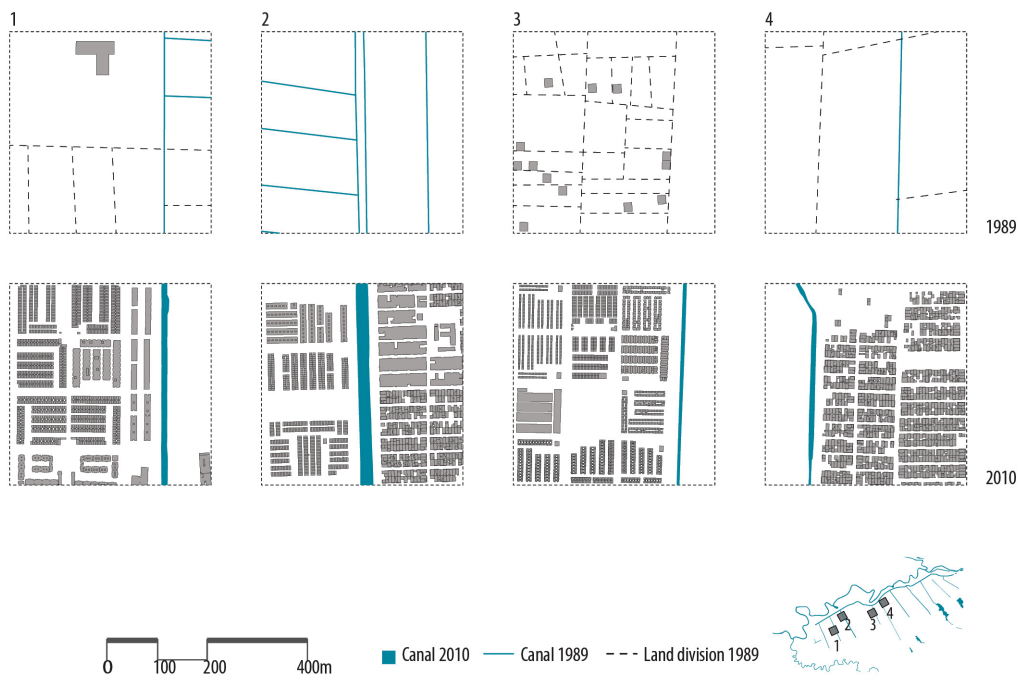
By 1991, the water and sewerage company of Bogotá EAAB formulated the project Santafe I. One of the main objectives of the project was to reduce flooding in El Tintal watershed. Another objective was the construction of sewerage networks in the periphery to enable the construction of large social housing projects. The works began in 2000 after the development of a new master plan for El Tintal watershed. This included the construction of the Canal Cundinamarca, a long canal parallel to the Bogotá River that collects rainwater from perpendicular canals and wastewater from new sewage interceptors [fig. 10]. These perpendicular canals follow the path of former colonial ditches. 248 hectares of land were suitable for housing development after the construction of the drainage system, including the projects Ciudadela El Recreo and Ciudadela El Porvenir for 15,918 dwellings units for low-income housing and other private developments.

In spite of the huge investment in infrastructure, the inhabitants of the watershed must continue to endure flooding. In less than 10 years, three major floods left hundreds of houses under water. This clearly demonstrates the failures of the hard traditional engineering approaches. The fear of a water-based calamity has resulted in hindering a healthy perception and relationship with water. In addition, the lack of connectivity between the urban fragments as well as the social issues of the inhabitants combine to create an atmosphere of insecurity and detachment in relation to the water infrastructure.

The shortcomings of the urban periphery are also the result of the distribution of private space. The elongated block is the ordering principle of urban form. This is conditioned by the addition of small plots formed in a row. The generic block is multiplied with indifference to the water system and the interface between public and private space is undefined (Tarchopulos & Ceballos 2005: 107) [fig. 11]. A water system was inserted as a technical 'hard' engineering solution, but due to its lack of integration with the urban form, it works as an urban barrier between the different neighborhoods missing the opportunity for a strategic intervention.



[fig. 10] A hard water infrastructure was inserted to reduce flood vulnerability. The mismatching of scale strengths contested relations with the water.



[fig. 11] In both, the formal (1 and 3) or the informal (2 and 4) developments the elongated block is the ordering principle of urban form. The shift from hard to soft engineering is an alternative to re-qualify the generic and monotonous urban form in the periphery.



[fig. 12] The current water system has the potential to absorb the demands for public space and equipment. Pictures of the Canal Cundinamarca and the perpendicular canals.

CONCLUSION

The reading of the transformation of the landscape of El Tintal has shown how the interventions of the water system were instrumental in the different stages of development. These interventions constitute different layers that can be read and re-interpreted to support the new paradigm in water management. The focus of this paradigm shift should be in line with the requirements of spatial qualification of the generic periphery of Bogotá. Part of the crisis of water in Bogotá is the result of stretching the use and abuse of landscape from colonial times. In the pre-Hispanic past the Bogotá River and its floodplain were a source of livelihood for the people who lived on its banks. Today the river is a neglected space that reinforces the geography of marginality and inequality.

In this line, the discussion of a new paradigm in water management in Bogotá must begin with restoring the balance between the water system and urbanization. One of the persisting major challenges is to provide around 300,000 new low-income housing units. With the integration of the 'soft' water related infrastructure, there is an opportunity to restructure the urban tissue and to provide high quality public space. The re-incorporation of cultural meaning of water and the re-programming of uses should be intertwined with the new water infrastructure. This integration will hopefully respond to the spatial challenges of rapid urbanization and sub-urbanization of the Savanna. The traditional large-scale superimposition of master planning has proven to be an inadequate approach for dealing with the informal city and the scale of the environmental problems of the Savanna of Bogotá. New spatial strategies should be based on design explorations that integrate the logics of the landscape and understand its social and cultural construction.

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